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TWENTY-SIXTH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

Approximately 250 persons, including delegates from 27 States and the District of Columbia, and 11 State weights and measures associations, manufacturers of weighing and measuring appliances, and others interested, attended the Twenty-Sixth National Conference on Weights and Measures which was held in Washington, June 9–12, inclusive. The sessions on June 9, 10, and 11 were held at the Bureau and on June 12 at the Washington Hotel.

Dr. Lyman J. Briggs, Director of the Bureau and president of the conference, gave the welcoming address which was followed by reports of the State delegates and of the State associations of weights and measures officials. Practically the entire afternoon session of the first day was devoted to problems of the local weights and measures official. The paper by George M. Roberts, superintendent of weights, measures, and markets of the District of Columbia, Observations on the Fee System of Inspection of Weights and Measures, excited a great deal of interest; this system was represented as having many disadvantages which should discourage its general adoption.

The morning of the second day's session was devoted largely to the problems of installation, maintenance, and testing of large capacity motortruck scales. At this session Dr. Briggs announced the decision of the National Bureau of Standards to inaugurate a program for the testing of motortruck scales in cooperation with the States. He explained that the necessary equipment was being purchased, which will include a specially designed truck equipped with a swinging boom, traveling trolley, and hoist, all power operated, for handling the 15 weights of 1,000 pounds each with which tests will be made. All necessary smaller weights and auxiliary equipment will

also be provided. Testing will be done only in accordance with programs arranged by the State authorities. Reports will be made to the proper officials with summary reports covering entire States and cities. It is expected that through these careful tests of large-capacity motortruck scales, officials of many jurisdictions will be furnished for the first time with accurate information concerning the condition of these scales. If this condition should prove to be unsatisfactory (as is expected), these officials will have actual data on which to base arguments for suitable testing equipment. The Bureau does not expect to continue work in this field for any great length of time. Dr. Briggs made it very clear that this was in the nature of temporary aid by the Federal Government to the States to help them in inaugurating proper testing programs of their own.

Important papers delivered at this session included: The Installation and Maintenance of Large-Capacity Scales, by Albert Veth of the Fair Scale Co., Louisville, Ky.; Recent Activities of the National Scale Men's Association, by R. O. Rask, president of the association; and End Testing Versus Corner Testing for Motortruck Scales, by M. J. J. Harrison, chairman, committee on method of test of motortruck scales, National Scale Men's Association. Added interest was lent to this session by illustrated descriptions of five new equipments for motortruck scale testing, two of which, owned respectively by the State of New Jersey and the city of New York, were brought to the Bureau for inspection during the conference.

The afternoon session on the second day was devoted to an inspection tour of the Bureau's laboratories. Practically every laboratory of the Weights and Measures Division was visited and a sufficient number of others to give a good general idea of the Bureau's work.

On the third day's session an address was delivered by Hon. Ernest G. Draper, Assistant Secretary of Commerce. Mr. Draper brought out the close relationship which should exist between the Department and the weights and measures official, since the object of both is to facilitate the commerce of the United States. Mr. Draper described briefly the activities of the various bureaus of the Department and pledged their aid to the weights and measures official.

The business on the third day was devoted principally to petroleum products and included a paper on the Drainage Characteristics of Dispensers for Canned Lubricating Oil, by Ralph W. Smith, of the National Bureau of Standards, and Air Elimination for Vehicle-Tank Meters, by C. D. Baucom, superintendent of weights and measures of North Carolina. In this connection the conference later requested the Bureau, by resolution, to make a further study of air elimination and also to make provision for testing meters used for petroleum products with some liquid other than water. It was pointed out that unsatisfactory results are secured when meters for the use of gasoline are tested with water.

At this session an extremely interesting paper on The Administration of Weights and Measures in Great Britain, by Hon. R. J. Trump, Controller of the Standards Department, Board of Trade of England, was read by the secretary of the conference.

The morning session on June 12, held at the Washington Hotel, was notable because of an important paper on the Supervision over Meats and Meat Products under the Federal Meat Inspection Act delivered by Dr. R. H. Kerr of the Bureau of Animal Industry, United States Department of Agriculture. This paper was followed by a long and animated discussion, showing the intense interest in this subject by weights and measures officials. A paper on The Regulation of Utility Meters, by P. L. Holland, chief engineer of the Public Service Commission, State of Maryland, was also the subject of much interest.

At the final session, on the afternoon of June 12, the election of officers for the ensuing year took place. The following officers were chosen: President, Dr. Lyman J. Briggs, Director of the Nautical Bureau of Standards. Vice presidents—C. D. Baucom, State Superintendent of Weights and Measures, North Carolina; C. J. Cullen, Director, Bureau of Standard Weights and Measures, Pennsylvania; J. J. Levitt, State Superintendent of Standards, Illinois; John P. McBride, Director, State Division of Standards, Massachusetts. Secretary—F. S. Holbrook, National Bureau of Standards. Treasurer—George F. Austin, Jr., Supervising Inspector, Bureau of Weights and Measures, Detroit, Mich. In addition, an executive committee of about 20 members was chosen.

It is expected that the complete report of the conference will be published by the Bureau within the next few months.

CONFERENCE OF AGRICULTURE, INDUSTRY, AND SCIENCE

The Bureau was represented by Frederick Bates at the Second Conference of Agriculture, Industry, and Science May 12–14, inclusive, held under the sponsorship of the Farm Chemurgic Council and The Chemical Foundation, at Detroit, Mich. Approximately a thousand delegates were in attendance. The session attracted Nation-wide attention, representing a cross section of the scientific, technical, and executive interests of the country, drawn together with the common purpose of creating and furthering new developments for products of the soil.

The two major subjects, if such can be selected, were power alcohol and sugar developments. Among the outstanding addresses were those by Heber J. Grant, president; L. D. S. Church, Salt Lake City; and William J. Cameron of the Ford Motor Co. Other important contributions were: The American Farm Problem, by Dr. Alonzo E. Taylor, director of the Food Research Institute, Stanford University; The Application of Physics to Agriculture, by Dr. George R. Harrison, professor of physics, Massachusetts Institute of Technology; What Agriculture Owes to Science, by Edward A. O'Neal, president of the American Farm Bureau Federation; Science in Industry, by C. M. A. Stine, vice president, E. I. du Pont de Nemours & Co.; The Relation of Power Alcohol to Our Economic Problems, by Francis P. Garvan, president of the Chemical Foundation; Jerusalem Artichokes, by Dr. W. L. Burlison, head of department of agronomy, University of Illinois.

The larger general session of the council was given over to a very broad discussion of the subject of power alcohol. This included not only the question of the economic feasibility and advisability of the use of anhydrous ethyl alcohol in motor fuels, but also thoroughly covered the technique of alcohol production, including available and possible sources of raw materials. The conviction was apparent among the numerous experts present that the use of alcohol in American motor fuels is inevitable and imminent.

The subject of the sugars and the starches occupied one session, and practically all phases of America's diverse sugar and starch industries were represented. A thorough and constructive discussion on these subjects finally became concentrated on methods for increasing the production of sugar in the United States. A valuable paper on the general subject had previously been presented by Heber J. Grant, of Salt Lake City. The Bureau was given permanent committee representation.

THE CERTIFICATION PLAN

An analysis of the status of the preparation and the utilization of specifications reveals the fact that many excellent specifications, well recognized throughout industry, are not widely used because of the inability of most purchasers to determine whether or not commodities delivered correspond to the specification requirements. Specifications would, doubtless, be much more widely used if this disadvantage to the small-quantity purchaser were eliminated. As a solution to this problem of facilitating the use of specifications, the Bureau "certification plan" has been developed. This plan, as carried out by the Division of Codes and Specifications of the Bureau, consists in the compilation and distribution of lists of sources of supply and commodities covered by certain selected Federal specifications and commercial standards. These lists contain the names of firms who have indicated their willingness to certify to purchasers, *upon request*, that the material supplied by them on contracts based on the selected specifications and standards *does actually comply with the requirements and tests thereof and is so guaranteed by them.*

The certification plan is not only widely utilized by "public purchasers", that is, purchasers for the Federal, State, and municipal Governments, who are spending money collected from the public in the form of taxes, but it is also being welcomed by responsible manufacturers and representative trade associations as well as by many other purchasers, both organized and unorganized.

Thus far, there have been prepared lists of willing-to-certify sources of supply for approximately 525 Federal specifications and commercial standards, representing more than 21,000 separate requests for listings from about 11,000 firms, covering 525 separate commodities. The earlier lists designated as Bureau of Standards Letter Circulars LC256 and LC256a are out of print, and copies are no longer available. These two are being superseded by supplements which will contain the earlier lists in revised form, in addition to other lists belong-

ing in certain designated groups. Supplements 1 and 2 to LC256a, which are now under revision, are not available at this time. However, copies of lists designated as supplements 3, 4, and 5 to LC256a are now ready for distribution to tax-supported agencies. Supplements now available and others in preparation are indicated below.

Supplement

3. Softwood, lumber and timber manufacturers, wholesalers, and retailers.
4. Brooms and brushes.
5. Chemicals, cleaning, and polishing materials.
6. Coal and products, coal tar and products, and insulating materials.
7. Ceramics, furniture, glass and glassware, and hardware.
8. Office paste, leather, inks, and paper.
9. Instruments, machinery, pipe and pipefittings, scales, and tools.
10. Minerals and products, including asphalt, brick, cement, gypsum, lime, plaster, refractories, roofing, tile, etc.
11. Metals and metal products.
12. Cordage and textiles.

Further information concerning the application of the certification plan or any other phase of the work on standardization, including the labeling plan, may be obtained from the Division of Codes and Specifications, National Bureau of Standards, Washington, D. C.

Copies of Federal specifications are not available from the National Bureau of Standards, but may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for a nominal sum, usually 5 cents a copy.

COMMERCIAL STANDARD FOR OAK FLOORING

A Commercial Standard CS56–36, Oak Flooring, became effective March 15, 1936. This standard was developed by the National Oak Flooring Manufacturers' Association and established in cooperation with the Bureau as a basis of understanding between producers, distributors, and users.

Since oak flooring is basically a natural product, its fundamental qualities cannot be changed. However, it can be carefully segregated, according to its freedom from defects, into several grades of varying beauty and utility.

For more than 27 years the associations active in this industry have worked toward standardization of grades with an excellent record of success. However, in order to bring about a more general distributor and consumer acceptance of the association grades, these grades were recommended as the commercial standard for oak flooring and subsequently were accepted by practically all of the more important producers and wholesale and retail lumber dealers, as well as by numerous architects, builders, and other users, and are now being promulgated as the standard grading specifications for the industry.

Both plain and quarter-sawed grades are included, and the specification sets forth those characteristics which they may or may not contain. Further requirements are those of minimum and average lengths for the several grades.

Dimensions are given for the various standard sizes, and the drawings show for the first time the various detailed dimensions which will permit the manufacture of a truly standard product, allowing the laying of an attractive and serviceable floor of material from different sources. The subject of inspection and reinspection is also covered.

In order to assure the builder that he is receiving the grade of oak flooring ordered, the National Oak Flooring Manufacturers' Association has devised a certification plan under which the members of the association may guarantee conformity to the commercial standard. This guarantee is further certified by the association and controlled through a centralized inspection service. Copy of the label to be used is published in the commercial standard.

Since the finest oak flooring obtainable may be ruined by improper handling and installation, there has been appended to the Commercial Standard, certain manufacturers' recommendations, the careful adherence to which should provide a satisfactory floor.

The pamphlet also includes a list of the official acceptors of the standard, together with the membership of the standing committee, which will consider the necessity for future revisions. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each. A discount of 25 percent is allowed on 100 or more copies.

COMMERCIAL STANDARD FOR BOOK CLOTHS, BUCKRAMS, AND IMPREGNATED FABRICS

Commercial Standard CS57–36, Book Cloths, Buckrams, and Impregnated Fabrics (For Bookbinding Purposes Except Library Bindings), has just been released. It records the voluntary understanding accepted by book-cloth manufacturers, publishers, bookbinders, and others directly concerned, as a national basis for pur-

chase, inspection, acceptance, tests, and certification of quality of book cloths. The standard establishes six classifications, three for book cloths and three for buckrams, as a means of designation between buyer and seller.

The requirements for each classification include thread count, breaking strength, stripped-cloth weight, methods of sampling, test conditions, and test methods.

The pamphlet includes a brief history of the project, the membership of the standing committee which reviews proposed revisions, and a list of official acceptors. The standard became effective March 1, 1936.

According to producers and users, the standard will serve to round out the understanding between buyer and seller on those characteristics which are not readily determined from visual inspection. It will serve as a basis for fair competition and will tend to eliminate much of the misunderstanding and uncertainty of the past in purchases of this commodity.

The original draft was prepared by the Employing Bookbinders of America and the Book Manufacturers Institute in cooperation with the Institute of Book Cloth and Impregnated Fabrics Manufacturers and was based on data obtained at the Government Printing Office.

The Commercial Standard was approved by the American Standards Association on April 3, 1936, as American Tentative Standard CS57–36.

The wording of a uniform guarantee label by means of which the seller certifies quality to the buyer, is incorporated in the pamphlet. Copies are obtainable from the Superintendent of Documents at 5 cents each.

SIMPLIFICATION OF FILM WIDTHS FOR MICRO-PHOTOGRAPHY OF RECORDS

The proposed simplification program for film used in microphotography has been approved by representatives of those at interest, and the recommendation will become effective August 1, 1936.

Simplified Practice Recommendation R165–36 is intended to serve as the first step in the direction of orderly advancement of the art of copying. It establishes two standard stock widths of motion-picture film for this use, 16 and 35 mm, respectively. Photographic copies made on such film have been variously described as "micro-copies", "film slides", "filmstats", etc. It is expected that a uniform nomenclature, international in usage will emerge from a present consideration of terms commonly used in this field.

A representative standing committee will keep the recommendation abreast of current technical research on the relationship of film width to lens systems, sprocket holes in films, recorded image-size, reduction ratio, and film emulsions. The study is being coordinated, to the end that essential apparatus may be designed, built, and distributed, with the assurance that abrupt changes in method or technique will not hamper the users.

The printed simplified practice recommendation will contain a brief history of the project. When the publication is ready for distribution it will be announced in this bulletin, and copies will be obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. Meanwhile, inquiries should be addresed to the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

ORGANIC PLASTICS

The modern-plastics industry deals chiefly with moldable materials manufactured from organic compounds. Synthetic resins, natural resins, cellulose derivatives, and protein substances are the four principal types of these organic plastics. The inorganic molding materials, such as concretes, cements, and ceramics, and also rubber (an organic substance), are not generally included within the scope of the plastic trade as it is known today, inasmuch as the industries utilizing these materials are considerably older and were already individually organized and developed prior to the advent of the newer plastics.

In order to meet a growing demand for information regarding the organic plastics, Bureau Circular C411 has been prepared on this subject. The various organic plastics are discussed from the standpoint of the raw materials required, the chemical reactions involved, the various methods of processing, and the more important applications.

The synthetic resins are subdivided into several chemical types as follows: Phenolic-aldehydic, amino-aldehydic, vinyl, hydroxy-carboxylic, indene, organic-polysulphides, and miscellaneous. Some of the more familiar industrial products which are discussed in this section of the circular are Bakelite, Catalin, Beetleware, Vinylite, Glyptal, Thiokol, and Duprene. Natural resins

of animal, vegetable, and mineral sources are described. Typical examples of the natural resins from these three sources include shellac, rosin, and asphalt, respectively. The chemistry of the cellulose esters and others and cellulose xanthate is outlined. Celluloid, Fiberloid, Plastacele, Tenite, and Cellophane are among the well known cellulose plastics discussed. The protein plastics considered include those prepared from casein (milk), blood albumin, and soy beans. Selected references are listed at the conclusion of the circular for the convenience of the reader who may be interested in further details regarding the manufacture, properties, and uses of organic plastics.

Copies of this circular are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

HIDING POWER OF PAINT

A new board to be used in determining the hiding power of paint has been constructed. This consists of 36 white and 36 black, opaque, glass squares (2 inches square) laid together in checkerboard fashion. In order to get the top surface as level and uniform as possible, the squares were laid face down on a smooth, level surface (a piece of plate glass), and cement placed on their backs, thus building up from the back of the squares. A layer of neat cement was laid next to the squares, followed by a 3:1 mixture of sand—portland-cement mortar. After waiting for 2 weeks for the cement to harden, the board was turned over, face side up, resulting in an excellent surface for brushing and applying paint. The area of the board is 4 square feet. The reflection factor of the white squares is 80 percent and of the black squares less than 1 percent. The squares of glass are so laid that no edge or frame hampers the brush in sweeping across the entire surface of the board. The board may be used for either dry or wet hiding power.

The board is mounted in a hood illuminated by light diffusely transmitted through a daylight filter from a bank of photoflood lamps. The color temperature of the transmitted light is about 6,500° K. The illumination on the surface of the hiding-power board is 165 foot-candles; it is uniform over the board, and it is mostly incident normal to the board or nearly normal. For those not equipped with a standard illuminant, viewing the board at a north window illuminated by a fairly light overcast sky will approximate the conditions. The direction of view is about 45° from the normal to the board.

SAFETY GLASS FOR GLAZING AUTOMOBILES

The motor-vehicle laws of several States require the use of safety glass conforming to the safety code recently adopted by the American Standards Association as American Tentative Standard Z26.1–1935.

The preparation of this safety code National Bureau of Casualty and Surety Underwriters, and the tests include for resistance to impact as determined by dropping: (1) a half-pound steel ball (2) a 7-ounce steel dart, (3) an 11-pound shot bag onto the glass from appropriate heights. In some cases the glass does not break and in other cases the type of fracture is the deciding factor. The glass was also tested for discoloration by exposing it to radiations from a quartz-mercury lamp and to the effect of moisture at 125° F. and 70-percent relative humidity. Glass for use as windshields was also tested for distortion by projecting the image of a straight line through the glass.

Several of the States asked the Bureau to make the tests for them. Nine domestic manufacturers of safety glass furnished 768 samples representing 32 types of glass which were then tested. There are three kinds of safety glass covered by the code, namely, laminated glass, wire glass (meshed wire), and the so-called heat-treated or case-hardened glass.

Reports of the tests were sent to motor-vehicle regulatory officials of 22 States who requested them and will be used (when applicable) by those officials for establishing lists of safety glass acceptable in those States. Reports may also be obtained by any other State official desiring them.

SUBSTITUTION OF DOMESTIC FOR IMPORTED CLAYS IN WHITEWARE BODIES

In preliminary work at the Bureau, American kaolin was substituted for English china clay in standard vitreous and semivitreous tableware, electrical porcelain, and sanitary-ware bodies, making the necessary adjustments in the other ingredients. In

making the clay substitutions it was necessary to consider also such properties as colloid content, base exchange capacity, shrinkage, and strength.

Test specimens were cast. From these the dry densities were determined. After heat treatment in an electric furnace the fired densities, volume shrinkages, and apparent porosities were determined. The correct vitrification temperature was assumed to be that temperature producing maximum fired density.

The English china clay bodies required about 5° C lower temperature than the American kaolin bodies to produce maximum fired density. This may be due to:

(1) Some form of magnesium which is present in English china clay and not in American kaolin (since experiment showed the temperature could be lowered approximately 5° C by incorporation of 0.2 percent of $MgCO_3$).

(2) Water vapor given off by the muscovite in English china clay, thus reducing the vitrification temperature, as reported by Badger.

It was difficult to distinguish the English china from the American kaolin bodies either in appearance or properties tested when both were heated to the same degree of vitrification.

Body samples were solicited from a number of whiteware plants and their compositions in terms of RO, RO_2, and R_2O_3 determined. The imported clay used in these bodies varied from none to nearly all of the clay content.

From the compositions determined, formulas were calculated, using half Kentucky no. 4 and half Tennessee no. 5 as the ball-clay content (a combination of American kaolins found to give good results in the previous work), Maine feldspar, and flint. These bodies were tested in the same manner as the previous ones.

All of them made good slip and cast well. After heat treatment their appearance was quite satisfactory. The variation in average fired density of the vitrified bodies was from 2.37 to 2.39, apparent porosity varied from 0 to 0.4, and volume firing shrinkage from 24.6 to 25.5 percent.

To establish the relation between RO content and vitrification temperature, a series of bodies lying along a straight line in the triaxial diagram of the $RO—RO_2—R_2O_3$ system was tested. This line was drawn so that the clay contents of the bodies were approximately 45 percent. The equations $T=1398—30R$, from $R=2.5$ to 4.75, and

$$T=\frac{R-6.5+1234}{0.3-0.08R}$$

from $R=4.75$ to 8.5, express the relation between vitrification temperature in °C and percentage of RO in the body.

Although the RO content (hence vitrification temperature) and ball-clay content (hence plasticity) of these bodies vary widely, the fired densities, volume shrinkages, and apparent porosities are extremely uniform.

The chief factors affecting the substitution of American for English china clays are the greater flux content of the latter and the greater fineness of the former.

Effects resulting from substituting domestic for foreign clays can be practically eliminated by proper choice of clays and method of body formulation. This has been done in the laboratory. Plant tests are in progress.

COMPRESSIVE STRENGTH OF MORTAR CUBES

A study has been made by the cement reference laboratory, maintained jointly by the American Society for Testing Materials and the National Bureau of Standards, of the variations in compressive strength of 2-inch mortar cubes resulting from various departures from planeness in the surfaces of bearing blocks. The tests were designed to furnish additional data for use in future considerations of the requirements for molds and bearing blocks as now appearing in the Tentative Method of Test for Compressive Strength of Portland Cement Mortars, ASTM C109–34T.

The cubes were tested under the following seven conditions of bearing surface of top and bottom bearing blocks: (1) Plane; (2, 3, 4) concave, with spherical curvatures such that the mid-ordinates, measured from a circular plane 2 inches in diameter, were respectively 0.001, 0.002, and 0.004 inch; (5, 6, 7) convex, spherical, with mid-ordinates the same as for the concave faces. Under each of the seven loading conditions, 24 cubes were tested at each of the ages of 1, 3, 7, and 28 days.

It appears that the present tolerances of the C109–34T specifications are not too stringent, and that departures from planeness of bearing blocks, in excess of these tolerances, but within the limits of surfaces of some blocks and molds which have been observed, may be responsible for rela-

tively important variations in the strength determinations on 2-inch cubes.

WATER ABSORPTION OF BUILDING BRICK

At the 1936 meeting of the American Society for Testing Materials a paper was presented by J. W. McBurney, comparing results of various techniques in determining water absorption of building brick by the 5-hour boiling method. The test specimens consisted of 30 bricks, 8 of which were made by the de-airing process. The 22 non-de-aired bricks included specimens made of clay or shale or mixtures thereof, and represented the three commercial methods of forming.

The methods of testing included comparisons of results of boiling dry bricks previously soaked in cold water for 24 and 48 hours; forced cooling in 1 hour compared with slow cooling for over 16 hours after boiling; the effect of varying the degree of cooling, of failing to reach boiling temperature and of variation in time and temperature of drying.

The conclusions are:

1. Drying for 72 hours at a temperature of 110 to 115° C. in a ventilated oven is sufficient to bring non-de-aired brick of moderate to high water absorption (above 8.0 percent by the 5-hour boiling test) to dry weight constant to ± 0.5 gram.

2. Certain less absorptive bricks and certain de-aired bricks are not dried satisfactorily by the above treatment, and exposure to a temperature of 110 to 115° C for 5 days is required.

3. For non-de-aired bricks of moderate to high absorption (above 8.0 percent by the 5-hour boiling test), the difference between the results of 5-hour boiling followed by thorough forced cooling in 1 hour, and the same test followed by 16 hours slow cooling is negligible.

4. The higher the temperature of the bath at the time the brick specimen is removed for weighing, the lower the weight of absorbed water.

5. The use of incompletely dried test specimens results in error, unpredictable in size and direction, depending apparently upon the nature of the brick.

6. Confining consideration to methods believed to conform to a reasonable interpretation of the 1935 Tentative Methods of Testing Brick C67–35T, the 5-hour boiling test for absorption on sound bricks of moderate to high absorption (above 8.0 percent by 5-hour boiling) is, in general, reproducible to within ±0.15 percent.

SOLUBILITY OF CALCIUM 2-METHYLBUTYRATE IN WATER

Nearly 50 years have elapsed since the single previous series of determinations was made of the solubility of calcium 2-methylbutyrate in water. Since that time, other investigations of a similar nature have indicated that the type of solubility curve obtained is incorrect. Furthermore, though nearly all the investigators who have dealt with this salt found that it contained 5 molecules of water, one stated that it had 5 molecules at 0° C, 3 at 23 to 26° C, and 1 at 85 to 90° C, when in contact with saturated solution.

As the result of an investigation described in the July number of the Journal of Research (RP902) it has been found that the form with 5 molecules of water is in equilibrium with the saturated solution at temperatures between 0 and 36.5° C. Above this range the salt contains 1/2 molecule of water of crystallization. The solubility of the salt is found to increase from the equivalent of 23.05 g of anhydrous salt per 100 g of water at 0° C. to 2990 g at 36.5° C. The solubility then decreases with rising temperature until it reaches a value of 19.80 g of anhydrous salt per 100 g of water at 100° C. It is believed that the apparatus and technic used give solubility data correct to 0.1 g of anhydrous salt per 100 g of water.

FORCEPS FOR HANDLING RADIOACTIVE SUBSTANCES

Light-weight forceps have been designed and constructed at the Bureau which permit the operator to pick up radioactive samples, with the nearest part of the hand at least 20 cm from the sample. These forceps automatically grip and hold objects in the jaws by means of spring pressure. Pressure is applied by the operator only when it is desired to open the jaws to pick up or release a specimen. They may be made in right- and left-hand models and the jaws may be formed to pick up tubes of radium a millimeter or less in diameter. It has been found that several different forceps with specially formed jaws are desirable if tubes of a wide range of diameters are to be handled.

VELOCITY OF FLAMES FROM GAS BURNERS

The velocity with which flame is propagated in the combustible mixture issuing from the ports of a gas burner

is one of the important factors which must be taken into account in any study of the performance and design of such burners and of the utilization of the various fuel gases which are supplied to the public. A better understanding of flames and the speed with which they travel would lead to more effective, satisfactory, and safe utilization of these gases.

Notwithstanding the years of study which have been devoted to flames and the mechanism of combustion, many workers using different methods still obtain different results which cannot be readily correlated or even compared on a common basis. This comes largely from the profusion of variables, some of them controllable, some not, and some probably unknown.

A study of the burner method of measuring flame velocities has been made at the Bureau, one object of the study being to separate, one from the other, the effects of changing the size of the burner port, of changing the rate of flow and composition of the combustible mixture, and of using measurements of different quantities and of different parts of the flame surface in computing the result. The apparatus and procedure are described in detail in RP900 in the July number of the Journal of Research.

The relationships developed between the size and shape of the flame surface as related to the diameter of the burner port and the composition of the mixture lead to the following conclusions:

(1) The most consistent results by the burner method are obtainable when using mixtures in nearly theoretical proportions in laminar flow from burner ports over 4 mm in diameter, and then computing the result by multiplying the average velocity of flow of the mixture by the sine of the angle between the axis and side of the flame surface at a point 0.7 the radius of the port from the axis.

(2) While the range of operations within which the burner method is capable of yielding reliable results is restricted considerably by the effects of the several experimental variables on the shape of the flame surface, yet it appears to be as simple and useful as any of the methods available at present. A knowledge of its limitations is essential, however, if erroneous conclusions from results obtained with it are to be avoided.

A derivation of the shape of the flame surface by the application consecutively of a series of facts, and assumptions based on facts, lead to the conclusions that: (1) The flame speed at the extreme tip may be several times as great as it is over the rest of the flame surface; (2) the flare at the base of the flame surface where it overhangs the burner port is better explained in terms of the magnitude and direction of flow of the gas mixture than by a cooling effect of the port; (3) the gap between the flame and the metal port is considered to represent the distance required by the temperature gradient from the port to the flame front, and, in consequence, represents approximately the thickness of a gradient layer underlying the entire flame surface, without specific assumptions regarding the mechanism involved in the propagation of the flame; and (4) the curvature of the surface of most flames changes from concave at the base to convex at a considerable distance from the extreme tip. This is thought to be caused more by a modification of the originally parabolic distribution of the velocity of flow of the gas mixture, after leaving the burner tube than by an increase in the flame speed resulting from a higher initial temperature of the combustible mixture.

DISTRIBUTION OF ENERGY IN THE EXTREME ULTRAVIOLET OF THE SOLAR SPECTRUM

Supplementing data given in a previous publication (J. Research NBS 16, 315 (April 1936) RP877), a paper in the July number of the Journal of Research (RP899) gives further calculations and graphs showing the distribution of energy in the extreme ultraviolet of the solar spectrum for various air masses traversed by the rays, at a sea-level station (Washington). The spectral energy distribution of solar radiation outside the earth's atmosphere (obtained by extrapolation of the data) is also given, showing that there is no similarity with the radiation of a black body at 6,000° K, which is sometimes used in calculating the ultraviolet solar spectral energy.

The second part of the paper describes a procedure for measuring the spectral quality and total intensity of ultraviolet solar radiation at high altitudes by means of a photoelectric cell and filter radiometer transported aloft in free balloons.

INTENSITY DISTRIBUTION IN THE LINE EMISSION SPECTRUM OF CESIUM

The intensity in a series of lines is $J_n = h\nu N_n A_n$ where N_n is the number of atoms per cm^3 in the *nth* state and

A_n is the rate of radiation per atom. A_n is proportional to n^{-3} for large values of n, while for a limited range of conditions N_n is known to have a temperature distribution.

RP901 in the July number of the Journal of Research, describes an investigation in which line intensities were measured by direct comparison with spectra of a strip lamp. Plots of log J/ν^4 versus log n give parallel curves for the S, D, and F series and the form of the curve is nearly independent of current and pressure for pressures above 70μ. Measurements of the D series corrected for self-absorption give plots of log Jn^3 versus term energy which are straight lines with slopes consistent with measured values of reversal temperature for the P series. Measurements of intensity of two D series lines over a wide range of conditions show that the intensities are proportional to the continuous spectrum intensity at the higher pressures.

For pressures above 70μ the excited states have a temperature distribution n=4 to 14. For the D series

$$A_n = \frac{4.3 \times 10^8}{n^3} \frac{\lambda_n}{5635}.$$

The values of $A\nu^3$ are about twice the theoretical hydrogen values. The values for the F series are also about twice the hydrogen values, while for the S series they are 16 times the hydrogen values.

There is evidently an equilibrium between the number of ions and the number of excited atoms at high pressure and in the same range of discharge conditions the temperature distribution of excited states is found.

ANALYSIS OF THE FIRST SPECTRUM OF VANADIUM

Light from vanadium vapor excited to luminosity in an electric arc, when dispersed by a spectrograph is seen to consist of several thousand different monochromatic radiations. These radiations resulting from atomic energy changes are controlled by quantum theory and their interpretation, therefore, leads to deductions of atomic structure. All available data for 2,500 such radiations or spectral lines are compiled and analysed in RP906 in the July number of the Journal of Research. The wavelengths range from ultraviolet (2000 A) to infrared (12000 A), and these fundamental data are supplemented by estimated relative intensities, temperature excitation stages, line splitting in magnetic fields (Zeeman effect), and absorption observations.

The analysis resulted in the identification of 60 doublet, 60 quartet, and 28 sextet terms (atomic-energy states), which combine to explain 2,186 observed lines. The principal features of the first spectrum of vanadium are thus disclosed, the descriptive material is satisfactorily interpreted and correlated, and all is found to be in excellent agreement with the modern theory of complex spectra. The spectrum is accounted for by 5 (valence) electrons out of a total of 23 in the extra-nuclear structure of vandium atoms, and most of the identified spectral terms have been definitely assigned to particular electron configurations. The most intense line of the entire spectrum is a violet one (4379.-24 A) due to simple transition of a single electron between quantum states represented by azimuthal quantum numbers zero and one. This line is extremely sensitive for spectroscopic detection of vanadium.

Series of spectral terms have been recognized, which, when extrapolated to the limit, lead to a value of the energy (ionization potential) required to remove an outer electron from a vanadium atom. Thus it is found that a free electron falling through a potential difference of 6.71 volts acquires just sufficient energy to knock off an electron from a vanadium atom upon collision.

MEASUREMENT OF ELECTROLYTIC RESISTANCE

In certain precise measurements of electrolytic resistance the platinum electrodes are necessarily very thin so that the drop of potential in them cannot be neglected. In RP905 in the July number of the Journal of Research, formulas are obtained for this drop in the case of two types of cylindrical cells, one in which the current is axial, the other partly axial and partly radial. The potential admits of accurate evaluation in the first case and the results obtained confirm the method outlined for the treatment of a general shape of cell.

METAL RECTIFIERS FOR ELECTROPLATING

The electroplating industry requires low-voltage, direct current and this has been ordinarily supplied by motor-generator sets, which change the high-voltage alternating current of the power source. Another type of appa-

ratus, the cuprous oxide-metal rectifier, has been used for some time in the United States for various purposes such as charging automobile storage batteries. Recently in Europe, and particularly in England, this rectifier has been tried on a large scale in electroplating plants. The equipment includes a transformer with taps, a set of dry rectifier plates and a cooling fan in the larger sizes. The output of units has reached 12,000 amperes and the size of installations has reached 100,000 amperes. The units are built for various rated voltages, as low as 3.5 and as high as 10 volts.

The rectifiers show good efficiency, power factor, and voltage regulation, require very little attention, and may be located close to the plating tanks if desired.

RAPID ELECTRODEPOSITION OF IRON

The production of ductile electrolytic iron has been studied at the Bureau, using high current densities (from 100 to 300 amperes per square foot). It was found that the favorable range was extremely sensitive to the temperature, concentration of iron salts, and the acidity of the solution. The addition of calcium chloride and boric acid had no effect on the plating range. The study was made by measuring the tensile strength, elongation, and Brinell hardness of suitably prepared specimens.

DEFINITION FOR "CAST IRON"

Many definitions of materials are more or less of the "textbook" variety and are poorly adapted to serve in a practical way as a criterion or basis for differentiation of samples in case of dispute. Especially is this true when there is no sharp line of demarcation, as in the case of cast iron and steel. A criterion which would be useful in any legal action, such as might arise in the delivery of a doubtful material, is often very desirable. This subject was discussed at the recent meeting of the Bureau's Metallurgical Advisory Committee. Although no definite action was taken, the tentative definition which had been under discussion and consideration at the Bureau was modified somewhat in accordance with recommendations made at this meeting. The amended tentative definition for cast iron which is under consideration is as follows:

"Cast iron is a cast alloy of iron and carbon, with or without other elements, in which the carbon content exceeds the maximum limit of solid solubility, as determined at any temperature (which in plain cast iron is 1.7 percent) and, hence, contains eutectic carbide or graphite as a structural feature. It is not usefully forgeable at any temperature."

This proposed definition follows along somewhat the same line as that recently suggested by the British Cast Iron Research Association, and the committee on cast iron of the American Foundrymen's Association.

DETERMINATION OF THE BRINELL NUMBER OF METALS

The Brinell test has been used extensively in testing metals ever since its introduction by the Swedish engineer, J. A. Brinell, in 1900. He proposed to measure a property of the metal (which has been called the Brinell hardness number or Brinell number) in the following manner: A 10-mm steel ball is forced into a specimen under a standard load, usually 3,000 kg, applied normal to the surface of the specimen, and the diameter of the indentation after removing the load is measured. From the diameter, the surface of the portion of the indenting ball that was embedded in the specimen is calculated, the ratio of the load to the surface being defined as the Brinell number of the metal. By definition the Brinell number is equal to the average axial stress with which the material will resist further indentation.

Brinell and others after him found that the Brinell number of an iron or iron alloy specimen was roughly proportional to the tensile strength of that alloy. The Brinell number was also found to be a convenient indicator of variations in work-hardening and other metallurgical properties in a given type of metal.

These valuable characteristics, together with the fact that the Brinell test is simple to make and, in contrast to the tensile test, does not involve destruction of the material, have led to its widespread adoption as an inspection test in the automotive industries and as a research tool in metallurgical laboratories.

With the increased use of the Brinell test it became important to reduce to a minimum the variations in determinations of the Brinell numbers of a given metal as measured by different observers at different locations. An extensive literature has conse-

quently grown up which treats of the effect on the value of the Brinnell number of different variables entering into the test. In the July number of the Journal of Research (RP903) there are brought together some of the results of such investigations and these have been supplemented by results of new tests and new analyses wherever the existing data seemed deficient. Discrepancies due to variations in test procedure, in the shape of the specimen, in the method of indenting, and variations in the type of ball used are considered at length. The conclusions of this review of old and new data on the Brinell test are summarized in recommendations for a test procedure designed to lead to greater concordance in the Brinell numbers obtained by different observers testing a specimen of given material.

NEW AND REVISED PUBLICATIONS ISSUED DURING JUNE 1936

Journal of Research [1]

Journal of Research of the National Bureau of Standards, vol. 16, no. 6, June 1936 (RP889 to RP898, inclusive). Price, 25 cents. Obtained by subscription.

Research Papers [1]

[Reprints from the March, April, and July 1936 Journal of Research]

RP870. Absorption of X-rays by lead glasses and lead barium glasses. George Singer. Price 5 cents.

RP875. Oxidation of wool: Effect of hydrogen peroxide on wool. Arthur L. Smith and Milton Harris. Price 5 cents.

RP876. Oxidation of wool: The lead acetate test for hydrogen peroxide bleached wool. Arthur L. Smith and Milton Harris. Price 5 cents.

RP899. Distribution of the energy in the extreme ultraviolet of the solar spectrum. W. W. Coblentz and R. Stair. Price 5 cents.

Circulars [1]

C411. Organic plastics. Gordon M. Kline. Price 5 cents.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents and $3.25, respectively.

MIMEOGRAPHED MATERIAL

Commercial Standards [1]

CS56–36. Oak flooring. Price 5 cents.

CS57–36. Book cloths, buckrams, and impregnated fabrics for bookbinding purposes except library bindings. Price 5 cents.

Technical News Bulletin [1]

Technical News Bulletin 230, June 1936. Price 5 cents. Obtainable by subscription.

Letter Circulars

Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The number of copies available is limited. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or to send copies automatically as issued.

LC469. Publications on temperature measurements. (Also contains copies of fee schedules and a list of standard samples.)

LC470. The reflectance of paints and pigments.

LC471. Thermal insulation. (Replaces LC421.)

LC472. Domestic electric and gas refrigerators. (Replaces LC412.)

Technical Information on Building Materials

The supply of these notes, each of which consists of 3 or 4 pages giving the important facts on some one aspect of the properties or use of building materials, is necessarily limited. Their distribution will be confined to Government officials concerned with building projects and to architects, engineers, and home builders. Requests should make clear the actual need for the information at the time of writing. Letters should be addressed to the Division of Codes and Specifications, National Bureau of Standards, Washington, D. C. The following notes have been issued since the list

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents and $3.25, respectively.

published in the June 1936 number of the Technical News Bulletin:

TIBM–17. Corrosion of metals used in house construction: Atmospheric corrosion of galvanized ferrous sheet metals.
TIBM–18. Painting plaster.
TIBM–19. Investigations of portland-cement stucco construction.
TIBM–20. Recommendations for portland-cement stucco construction.
TIBM–21. Finishes and maintenance of portland-cement stucco construction.
TIBM–22. Submerged corrosion of ferrous metals.
TIBM–23. Concrete masonry units.

OUTSIDE PUBLICATIONS [2]

Photometry and brightness measurements. R. P. Teele. J. British Inst. Cinematography (511 Theobalds Road, London, WC1, England, 4, 9 (May 1936).

Some effects of argon and helium upon explosions of carbon monoxide and oxygen. Ernest F. Fiock and Carl H. Roeder. Tech. Rep. 553 (Nat. Adv. Comm. Aeron., Washington, D. C.) (1936), 5 cents per copy from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Dimensional analysis of model propeller tests. Edgar Buckingham. J. Am. Soc. Naval Engineers (Navy Dept., Washington, D. C.) 48, 147 (May 1936).

The routine determination of boron in glass. F. W. Glaze and A. N. Finn. The Glass Industry (233 Broadway, New York, N. Y.) 17, 156 (May 1936).

Bonding strength of cold-setting refractory cements. R. A. Heindl and W. L. Pendergast. Bul. Am. Ceram. Soc. (2525 North High St., Columbus, Ohio) 15, 182 (1936).

Why standards deserve full support. M. G. Lloyd. Electrical Manufacturing (Gage Publishing Co., 232 Madison Ave., New York, N. Y.) 17, no. 5, 51 (May 1936).

[2] These publications are not obtainable from the Government, unless otherwise noted. Requests should be sent direct to the publishers.

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